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The Effects of Alcohol on Positive Emotion During a Comedy Routine: A Facial Coding Analysis

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Abstract

There is considerable interest in understanding the emotional effects of alcohol. While a great deal of experimental research has focused on alcohol's ability to relieve negative emotions, there has been far less focus on the effects of alcohol on positive emotions. Further, the available research on positive emotion tends to test alcohol while participants are alone. Yet alcohol is often consumed in social settings, and enhancing social pleasure is consistently identified as being a primary motive for drinking. We aimed to address this gap in the literature by investigating the impact of alcohol on positive emotional experience in a social setting. We used the *Facial Action Coding System* (FACS) to examine in a large sample the effects of alcohol on response to comedy in a group setting. Five-hundred thirteen social drinkers (51.9% female) were assembled into groups of three unacquainted persons and administered either a moderate dose of alcohol, a placebo, or a nonalcohol control beverage. Following beverage consumption, groups listened to a roughly 5-min comedy clip while their facial expressions were video-recorded. More than 5 million frames of video were then FACS-coded. Alcohol consumption enhanced enjoyment (Duchenne) smiles—but not non-enjoyment social smiles—and elevated mood ratings. Results provide multimodal evidence supporting the ability of alcohol to enhance positive emotional experience during a comedy routine delivered in a social context. More broadly, this research

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illustrates the value of studying emotion in a social context using both self-report and behavior-expressive approaches.

Keywords

Alcohol; comedy; humor; emotion; facial expression

For millennia, the prospect that alcohol consumption can influence emotional states has been apparent to drinkers (Fairbairn & Sayette, 2014). One of the most powerful anticipated effects when consuming alcohol is that it enhances social pleasure (Brown, Goldman, Inn, & Anderson, 1980). The belief that drinking alcohol is rewarding because it is pleasurable to "join in with people who are enjoying themselves" (Goldman, Brown, Christiansen, 1987, p. 206) may in part explain the motivation for drinking, and offer a social mechanism for understanding who is at increased risk for developing an alcohol use disorder. Despite these survey findings, there has been relatively little experimental scrutiny of the positive effects of alcohol, and in particular the rewarding effects that occur in social settings (Sayette, 2017).

Over the years there has been a call for research examining alcohol and positive affect (e.g., Lang, Patrick, & Stritzke, 1999; Sayette, 1993). Most alcohol consumption takes place in social contexts (Fairbairn & Sayette, 2014). In some instances, these social drinking settings simply offer opportunities for unstructured interactions with other individuals, without providing much in the way of alternative extrinsic pleasures (e.g., Kirchner et al., 2006). In other cases, social drinking contexts (e.g., concerts, sports bars, parties, and theaters) also offer drinkers opportunities to engage in activities that can themselves bring enjoyment, including sports, dancing, games and/or music (Single & Wortley, 1993). One common source of positive stimulation involves exposure to humor, and comedy clubs have been capitalizing for years on the magical combination of humor and alcohol. Indeed, humor appreciation (i.e., the perception that something is funny; McGhee, 1971), is one of the top perceived benefits of drinking (Orford, Krishnam, Balaam, Everitt, & Van Der Graaf, 2004). Although club owners long ago determined that minimum drink requirements enhance appreciation of their comics' efforts, surprisingly few experimental tests have been conducted. Accordingly, comedy routines may offer an especially useful method to test the impact of alcohol on positive affect, as they likely boast more ecological validity than experimental efforts to capture alcohol's effects on response to positive stimuli, such as pleasant slides (Stritzke, Patrick & Lang, 1995).

We are aware of just five prior studies that have examined the effects of alcohol on humor appreciation. Surprisingly, these studies offer little evidence that alcohol enhances responding to humor stimuli. Hetherington and Wray (1964) examined the impact of alcohol on individuals varying in trait aggressiveness and need for approval while observing cartoons with different content (aggressive, nonsense). Results did not indicate a main effect of alcohol across persons and types of cartoons, instead suggesting a complex relation between alcohol and humor. Vuchinich, Tucker, and Sobell (1979) investigated the role of a low dose of alcohol on participants' self-reported and observed humor in response to

humorous stimuli and reported that beverage content *instructions*, but not the beverage content itself, influenced observed laughter. Weaver and colleagues (1985) found an effect of alcohol to enhance humor appreciation on a self-report measure, but failed to observe an effect on facial expression (using a coding system with unknown reliability). Lowe and Taylor (1997) did report a main effect of alcohol, though few methodological details are offered to properly evaluate the study.

Finally, Ruch (1994) evaluated the effects of alcohol on humor appreciation. Participants drank alone, and following an absorption period, spent 20-minutes viewing slides containing jokes and cartoons associated with incongruity-resolution, nonsense, and sexual humor. Results failed to observe a main effect of alcohol on humor appreciation, though complex interactions between extraversion and various doses of alcohol were observed.

Taken together, findings from these studies do not provide compelling support for the conventional wisdom that alcohol increases humor appreciation. Several methodological issues, including small sample sizes, low doses of alcohol that may be inadequate to generate emotional effects (see Sayette, 1993), and potentially unreliable observational measures, may have influenced these outcomes. Perhaps most importantly, however, these prior studies appeared to test participants individually. Yet alcohol is a social drug and, particularly with respect to its rewarding effects, it often is consumed in a social context.

To address this gap in the literature, we sought to evaluate the impact of alcohol on humor appreciation in a social context. We recruited a much larger sample of participants than in prior studies and tested their responses in a group setting. There has been debate regarding how best to evaluate humor appreciation in response to comedy. Although self-reports can be valuable, typically questionnaires require participants to aggregate their subjective experiences over time and impose language on what may be a nonverbal experience. Self-reports therefore can be vulnerable to distortions and biases (Schwarz, 1999). Accordingly, as recommended by Ruch, we used the Facial Action Coding System (FACS; Ekman, Friesen, & Hager, 2002). FACS is an anatomically-based system that codes all visually discriminable facial movements, described as action units (AUs). Although it is labor intensive (we individually coded more than 5 million separate frames of video during the comedy clip), it is a reliable system offering the most systematic and comprehensive approach for coding facial expressions (Sayette, Cohn, Wertz, Perrott, & Parrott, 2001). Moreover, FACS has proven sensitive to a variety of affective manipulations and has advanced understanding of basic emotional experiences and clinical phenomena (see Ekman & Rosenberg, 2005). While recent studies have questioned the strength of the correspondence between enjoyment and particular facial expressions (Gunnery, Hall, & Ruben, 2013; Krumhuber, & Manstead, 2009; Parkinson, 2005), the use of FACS in combination with corresponding self-report measures of affect, and in a context in which enjoyment is expected (responding to comedy), provides optimal circumstances for its use. Pertinent to the present study, we have found FACS to be ideal for capturing spontaneous (unscripted) emotional experiences (Sayette et al., 2001). In line with the other FACS study to examine alcohol and humor—though participants in this prior study were tested in isolation (Ruch, 1995)—we also assessed self-reported mood and funniness immediately following the comedy clip.

This project represents a more than ten-year effort to collect the data and FACS-code millions of frames of video. It is the largest investigation of the effects of alcohol in social context and, to our knowledge, the largest study to employ FACS. Some findings from this dataset have been published (e.g., Fairbairn, Sayette, Levine, Cohn, & Creswell., 2013; Sayette, Creswell, Dimoff, Fairbairn, Cohn, Heckman, et al., 2012). The previous articles focused on the 36-min drinking period at the beginning of the experiment prior to the comedy clip, observing that alcohol consumption led to an increase in the occurrence of Duchenne smiles (Sayette et al., 2012). To date, we have not examined the impact of alcohol on humor appreciation. Accordingly, this manuscript focuses on a wholly distinct set of questions *using entirely different methods* than these previous publications. The present manuscript focuses on the effects of alcohol on response to a comedy clip that was presented to participants *following* the drinking period. (In this respect, this study is similar to the vast majority of alcohol studies that do not begin the key manipulations of the experiment until after beverage consumption is completed.) Three-quarters of the participants listened to the comedy routine in groups of three while one quarter listened while alone. As detailed in the methods section, usable video was only obtained for those participating in groups, and thus the primary aims of the study focused on the impact of alcohol in a group setting.

We predicted that in this group setting, alcohol consumption would exert a pharmacological effect to enhance positive affect in response to a comedy clip. While dosage-set effects have been described in the field, comprehensive reviews suggest that effects of alcohol on both positive and negative social-emotional experiences (e.g., social anxiety, aggression, bonding) appear to result from ingestion of ethanol more than the belief that one has been drinking alcohol (i.e., a placebo effect) (Bushman & Cooper, 1990; Sayette, 2017; Steele & Josephs, 1990). Consequently we hypothesized that alcohol conditions would enhance positive responding to humor stimuli relative to groups consuming either a placebo (i.e., told alcohol, received nonalcoholic beverage) or a no-alcohol control group. Unlike all but one of the prior studies, this three-group design allowed us to contrast two nonalcohol conditions that differed only in dosage-set (i.e., whether or not participants are told they are drinking alcohol, see Martin & Sayette, 1993). Consistent with Ruch (1995), we anticipated that our facial and self-report responses to the comedy clip would be correlated.

Method

The present study focuses on the impact of alcohol on response to a comedy clip. Because the comedy findings have not yet been reported, we provide additional detail regarding that aspect of the procedure below.

Participants

As noted previously (for detail see Sayette, Creswell, et al., 2012), 720 participants were recruited from local newspaper ads. Those passing an initial phone screening were invited to the Alcohol and Smoking Research Laboratory at the University of Pittsburgh for a more extensive screening session (see Supplemental Materials). Following informed consent we determined whether they met study exclusion criteria, which included medical conditions contraindicating alcohol consumption, past alcohol abuse or dependence (as indexed by the

fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders*; American Psychiatric Association, 1994), pregnancy, body weight more than 15% above or below ideal weight for height (Harrison, 1985), and discomfort with the drinking requirements of the study. Participants also had to affirm that they could comfortably drink at least three drinks in 30 min. The sample was 50% women; 83% European American, 11% African American, 2.5% Asian, 1% Hispanic, 2.5% other). Participants reported drinking two to three times per week and consuming an average of 4.29 drinks ($SD = 1.89$) each time they drank. All procedures were approved by the University of Pittsburgh Institutional Review Board.

Predrink Assessment

Participants were randomly assigned to groups of three unacquainted persons; each group was randomly assigned to drink an alcoholic beverage, a placebo beverage, or a nonalcoholic control beverage (isovolumic across conditions). All four gender compositions (0 females and 3 males, 1 female and 2 males, 2 females and 1 male, 3 females and 0 males) were equally represented in each beverage condition. Before group formation, participants completed an initial assessment that included measures of personality and state affect. (A complete list of measures appears in the Supplementary Materials.) We obtained a blood alcohol content (BAC) breath sample and had participants complete a subjective-intoxication scale (SIS), on which they rated their perceived level of intoxication from 0, "*not at all intoxicated*," to 100, "*the most intoxicated I have ever been*."

Drink Administration

Participants in each group were informed that they would consume their drinks together over a 36-min period before completing several tasks (the ostensible purpose of the study). Each drink was mixed in front of the participant. The alcoholic beverage was 1-part vodka and 3.5 parts cranberry-juice cocktail (a 0.82-g/kg dose of alcohol for males and a 0.74-g/kg dose of alcohol for females). For participants drinking this moderate dose of alcohol, the vodka bottle contained 100-proof (50%) vodka; for participants drinking the placebo beverage, the vodka bottle contained flattened tonic water. To increase credibility in the placebo-beverage condition, we smeared participants' glasses with vodka before they were brought into the room. These procedures provide a successful placebo manipulation, leading participants in the placebo-beverage condition to believe they had consumed alcohol (Martin & Sayette, 1993). Participants in the control-beverage condition were told that they would not receive alcohol and were given cranberry-juice cocktail.

After being seated around a circular table, participants received one third of their drink every 12 min and were asked to consume it evenly across these time periods. They also were asked not to discuss their level of intoxication. Each drink administration session was video recorded at 30 frames per second using a digital video-control system. Video cameras were visible in the experimental room; participants were informed that the cameras were in the room so the experimenters could monitor drink-consumption rates from an adjoining room.

Postdrink Assessment

After drink administration, we again assessed participants' BAC and asked them to complete the SIS measure. To help control for dosage set, we presented participants in the placebo-beverage group with BAC readings that ranged from 0.041% to 0.043% (randomly assigned; 0.043% is about the highest credible reading for participants in alcohol studies who have been given placebo beverages; Martin & Sayette, 1993). Next, participants provided a subjective index of intoxication, and rated their mood and level of social bonding (Creswell, Sayette et al., 2012; Kirchner et al., 2006). (See supplemental material for full list of measures included in this project.)

Comedy routine—Participants from one of every four groups were then dispersed into different rooms, while the other three groups remained intact. Participants in the latter condition stayed seated at the table at which they had consumed their drinks. After participants completed a brief decision-making task (see Sayette, Dimoff, Levine, Moreland, & Votruba-Drzal, 2012) they were told that they would listen to a roughly 5-min audio clip of comedian Jerry Seinfeld's stand-up act. [The clip (available upon request from the first author) consisted of a series of 29 jokes about the Olympics, scuba diving, and public speaking, none of which contained sexual or aggressive content.] Participants were asked to listen to the clip and when it finished to comment on it using a rating scale. A compact disc player was placed on the table equidistant from the three participants (or in front of the single participant if s/he was in the alone condition), such that all group members listened to the audio clip simultaneously. Following the clip, participants completed a brief form evaluating the comedy routine and a mood form. Participants rated the comedy routine on two Likert scales ranging from 0, "*not at all,*" to 10, "*extremely*" to indicate how funny and entertaining they found the audio clip to be (Sayette & Dimoff, 2016). As in our prior work (Sayette & Dimoff, 2016), these two measures were highly correlated, $r(720) = .89$, $p < .0001$; thus, a composite "enjoyment" variable was created using the average of the two variables ($\alpha = .94$). Participants also indicated whether or not they would recommend the audio clip to others (yes/no). Mood was assessed using an 8-item mood measure (Fairbairn et al., 2015) selected to represent all quadrants of the affective circumplex (Russell, 2003). Four negative mood states (annoyed, sad, irritated, bored) and four positive mood states (cheerful, upbeat, happy, content) were assessed. Participants reported the extent to which they felt each of these eight mood states using a Likert scale ranging from 0, "*not at all,*" to 5, "*extremely*." Scores on the four positive items were averaged to create the positive mood subscale, and scores on the four negative items were averaged to create the negative subscale (Positive mood $\alpha = .87$; Negative mood $\alpha = .70$). Participants then recorded a post-comedy BAC and SIS rating.

Participants in the group condition were recorded listening to the comedy clip using the video system described earlier. The remaining 180 "alone" participants listened to the comedy clip in separate rooms, none of which included digital video capability[1].

[1]The primary aim of this study was to examine participants' facial behavior in a group setting—the setting that mirrors common real-life drinking contexts. Group facial behavior was thus recorded using a highly reliable custom-designed video system. We did have a secondary interest in participants' responses to comedy in isolation, and thus set up recording capabilities in individual subject rooms.

Consequently, the primary focus of the current paper is on the 513[2] participants listening to the comedy clip in groups.

Finally, participants completed a post-experimental questionnaire that assessed perceived level of maximum intoxication (rated on a scale similar to the SIS scale) and estimated vodka consumption. Participants in the placebo- and control-beverage conditions were then debriefed. Participants in the alcohol condition had their BACs recorded, ate a light meal, relaxed, and were debriefed when their BACs dropped below 0.025%. Following debriefing, participants were paid $60 and permitted to leave (those who had consumed alcohol were forbidden to drive).

Data Coding

We used Observer Video-Pro software (Version 5, Noldus Information Technology, Wageningen, The Netherlands) to code time-locked video footage. As noted earlier, facial expressions in each recording were coded on a frame-by-frame basis. Coders of each participant's data were blind to beverage condition and to the behavior of other group members.

Facial coding—Facial AU duration (i.e., frame counts) during the comedy routine was coded by a FACS-certified coder. We assessed enjoyment by measuring the duration of participants' Duchenne smiles—defined by the combination of AUs 6 (contraction of outer part of orbicularis occuli "cheek raiser") and 12 (contraction of zygomatic major "lip corner puller"; Ekman, 1989). If AU 12 appeared without AU 6 then the expression was coded as a non-enjoyment "social "smile (Ruch, 1994). If AU 12 emerged before the appearance of AU 6 then the expression initially was scored as a social smile before transitioning into a Duchenne smile. Total duration was calculated by summing the frame counts for each type of smile across the comedy clip routine; frame counts were converted to seconds for use in analyses. A second FACS-certified coder assessed reliability for a randomly-selected subset of 50 participants. There were good levels of agreement for Duchenne and social smiles (κs = .81 and .79, respectively). We did not assess laughter separately from Duchenne smiles; the two have been found in past alcohol research to be "equally" effective in measuring response to humor (Ruch, 1995).

Data Analysis

The effect of beverage condition on behavioral (i.e., Duchenne and social smiles) and self-report (i.e., enjoyment and mood) responses to the comedy clip were analyzed using SAS v9.3. The initial set of analyses involve the 513 participants whose faces were coded while listening to the comedy clip in groups of three persons, while the self-reported enjoyment and mood ratings also include the 207 participants who were not video recorded. Because of the nested structure of the data, we used hierarchical linear modeling to account for the interdependence of participants' responses. Behavioral and self-report variables were examined in two-level models, with the group-level predictor variable (i.e., beverage

But we experienced equipment failure with these secondary individual video setups, and thus participants listening to comedy clips in isolation were not recorded.

[2]Due to a technical malfunction the first nine groups were not recorded.

condition) entered at Level 2. Because group size was small (n = 3), intercepts but not slopes were allowed to vary randomly across groups (Kashy & Kenny, 2000). As noted by Kenny and colleagues (2002), it is the variation in these intercepts that models the non-independence of groups.

Facial-expression variables were not normally distributed; thus we used hierarchical generalized linear modeling (i.e., SAS PROC GLIMMIX) with a Poisson distribution and overdispersion of residuals to examine these behavioral outcomes (see also Sayette, Creswell et al., 2012). The self-report measures of enjoyment and mood were modeled using SAS PROC MIXED; the recommend variable (yes/no) was modeled using SAS PROC GLIMMIX with a binary distribution. Participants' self-report responses did not vary as a function of whether or not they listened to the clip alone or with others (all *p*s > .08), and more importantly, there were no beverage condition interactions with this variable (all *p*s > .65); therefore, these terms were dropped from final models for parsimony. We first report results from the test of fixed effects, indicating whether or not there was a main effect of beverage condition (i.e., alcohol, placebo, control) on dependent variables. Significant results were followed-up using a complete, orthogonal set of contrast codes comparing the alcoholic-beverage condition with both no-alcohol conditions (codes: alcohol = −1, placebo = .5, control = .5), and the placebo-beverage condition with the control-beverage condition (codes: alcohol = 0, placebo = −.5, control = .5). Where appropriate, we used dummy coding to independently compare the placebo- and control-beverage conditions with the alcoholic-beverage condition. Analyses were rerun controlling for participant gender and gender composition of the group, and results were unchanged. Finally, we examined the relationships among the behavioral responses and self-report measures using SAS PROC MIXED with the COVTEST option and using standardized values for variables.

Results

Participants' BAC and SIS data throughout the session are reported in Sayette, Creswell, et al., (2012). Most pertinent to the present study, all participants reported a zero BAC at study outset and, immediately following the comedy clip, participants consuming alcohol recorded a mean BAC of .062% (SD = .011), while participants in the placebo and no-alcohol conditions both recorded mean BACs of .00 (SD = .001). SIS scores for the alcohol and placebo groups were 35.12 (SD = 16.90) and 8.90 (SD = 10.80), respectively, values that differed significantly, $F(1, 358) = 410.1$, $p < .001$. Nonalcohol control participants were no longer asked to rate their SIS at this point in the study.

Effects of Alcohol on Smiling

Like Ruch (1994) we examined both Duchenne smiles and what he refers to as "nonenjoyment displays" or social smiling. Table 1 shows descriptive statistics for dependent variables across beverage conditions. There was a main effect of beverage condition on Duchenne smiling duration during the comedy routine, $F(2, 168) = 3.06$, $p = .049$. Participants drinking alcoholic beverages displayed Duchenne smiles for significantly longer amounts of time than participants drinking nonalcoholic beverages (M = 89.8 seconds, SE = 1.94), $F(1, 168) = 5.32$, $p = .022$, $d = 0.27$. Duration of Duchenne smiles did

not differ between placebo-beverage and control-beverage participants, $F(1,168) = 0.45$, $p = .50$, $d = -0.12$. Follow-up contrast analyses showed that alcoholic-beverage participants' Duchenne smiling duration differed from placebo-beverage participants, $F(1, 168) = 5.80$, $p = .017$, $d = 0.32$, but not from control-beverage participants, $F(1, 168) = 2.27$, $p = .134$, $d = 0.17$. In contrast to the Duchenne smiling data, there was no effect of beverage condition on the duration of "nonenjoyment" social smiling during the comedy clip, $F(2, 168) = .12$, $p = .89$.

Effects of Alcohol on Self-Report Measures

Fifty-eight percent of participants reported that they would recommend the comedy clip to a friend, a value that did not differ by condition, $F(2, 237) = 1.13$, $p = .33$. Similarly, ratings of enjoyment did not differ by beverage condition, $F(2, 240) = .71$, $p = .49$.

There was a main effect of beverage condition on positive mood after the comedy routine, $F(2, 240) = 4.69$, $p = .010$. Participants drinking alcoholic beverages reported higher positive mood than participants drinking nonalcoholic beverages (M = 3.15, SE = .05), $F(1, 240) = 8.89$, $p = .003$, $d = 0.14$. Positive mood did not differ between placebo-beverage and control-beverage participants, $F(1, 240) = 0.50$, $p = .48$, $d = -0.04$. Follow-up contrast analyses showed that alcoholic-beverage participants' positive mood differed from both placebo-beverage participants, $F(1, 240) = 8.61$, $p = .004$, $d = 0.15$, and control-beverage participants, $F(1, 240) = 4.97$, $p = .027$, $d = 0.11$.

There was also a main effect of beverage condition on negative mood after the comedy routine, $F(2, 240) = 6.65$, $p = .002$. Participants drinking alcoholic beverages reported lower negative mood than participants drinking nonalcoholic beverages (M = 0.71, SE = .03), $F(1, 240) = 10.8$, p = .001, $d = -0.16$. Negative mood did not differ between placebo-beverage and control-beverage participants, $F(1, 240) = 2.49$, $p = .116$, $d = 0.08$. Follow-up contrast analyses showed that alcoholic-beverage participants' negative mood differed from both placebo-beverage participants, $F(1, 240) = 13.22$, $p < .001$, $d = -0.19$ and control-beverage participants, $F(1, 240) = 4.23$, $p = .041$, $d = -0.10$.

Relations Between Facial Expressions and Self-Report Measures

Duchenne smiling duration was associated with enjoyment, $\beta = 0.12$, $t(341) = 2.63$, $p = .009$, 95% CI [.03, .20], positive mood, $\beta = 0.34$, $t(341) = 7.95$, $p < .001$, 95% CI [.25, .42], and negative mood, $\beta = -0.29$, $t(341 = -6.83$, $p < .001$, 95% CI [−.38, −.21], in the expected directions. The strength of these relationships did not differ by beverage condition (all ps>.48). Social smiling was unrelated to any self-report measure (all ps > .16). Enjoyment ratings were not associated with positive or negative mood (both ps >.22). Positive mood was negatively associated with negative mood, $\beta = -0.43$, $t(479) = -12.97$, $p < .001$, 95% CI [−.50, −.37], which did not differ by beverage condition ($p = .38$).

Discussion

A major thrust of human experimental alcohol research has been to identify domains in which alcohol consumption is rewarding. The general idea is that alcohol can alleviate negative emotional states and enhance positive states, thereby reinforcing drinking behavior.

While some research has tested participants during unprompted resting states, many studies have observed participants while they respond to discrete affective stimuli. These latter studies have generated critical information necessary to understand the impact of alcohol in circumstances in which drinking typically occurs. Most often, such studies have examined the impact of alcohol following administration of a stressor (Sher, 1987). Far less experimentation has focused on the effects of alcohol on positive stimuli, and in particular on comedy manipulations. This omission is striking given the near universal acceptance of the notion that alcohol promotes emotional responding to humorous stimuli and the popularity of activities in which drinkers are exposed to humorous stimuli. This specific effect of alcohol is endorsed by many drinkers (Orford et al., 2004) and is commonly represented online (e.g., videos posted on *YouTube* frequently link alcohol intoxication and humor; Primack, Colditz, Pang, & Jackson, 2015).

Despite widespread belief that alcohol enhances humor appreciation, the few experimental studies of alcohol and humor have offered weak support. Because alcohol often is consumed in social settings, and because this seems to be especially true when humor is involved, it is notable that prior work tended to test the effects of alcohol on humor appreciation while participants were alone. Results of the current study, which included a social context, indicated that alcohol increased Duchenne (enjoyment) smiling while participants listened to an audio recorded comedy routine. Consistent with the data from Ruch (1994) alcohol had no impact on nonenjoyment social smiling (AU 12 alone), suggesting that alcohol was affecting enjoyment and not merely presentational concerns. (This conclusion is reinforced by the absence of any association between social smiling and the self-report measures of mood or enjoyment, whereas there were significant associations between Duchenne smiling and the various self-report measures of mood and enjoyment.) Alcohol also appeared to enhance positive and inhibit negative mood immediately following the comedy clip. Alcohol did not, however, affect enjoyment ratings. This pattern is consistent with humor research outlined by Ruch (2005). He found that participants in a positive mood evinced Duchenne smiles following humor stimuli at lower minimal levels of rated funniness than did those in a less cheerful state. That is, the present study, by administering alcohol, appeared to increase positive mood and enhance Duchenne smiling, even when enjoyment ratings were not elevated. Also consistent with the present study, Ruch (2005) reported (in a study that did not include alcohol consumption) that this pattern was more evident when participants were in a social setting than when alone (see also Fridlund, 1991). Accordingly, alcohol when consumed in a group setting may lower the funniness threshold for smiling at jokes.

More recently, FACS researchers have begun to reexamine smiling. While AU 12 is a core element of the smile, investigators have raised questions about the precise degree of representation between the Duchenne smile and felt happiness. For instance, Rychlowska et al. (2017) linked this AU to three distinct types of smiling (reward, affiliation, and dominance). Depending on other facial features (e.g., facial symmetry, apex durations, see Krumhuber & Manstead, 2009) the interpretation of AU 12 (and the Duchenne smile more broadly) changes. We did not design the present study to make such distinctions, however, and future research would be most useful to tease apart what we and others (e.g., Ekman & Rosenberg, 2005; Ruch, 1994) consider to be an enjoyment smile to assess aspects of affiliation and dominance, both of which could plausibly appear during a group comedy

experience. Future research examining smile onset also would be useful. We take some comfort, however, in the findings of a recent meta-analysis suggesting differences in the perceptions of Duchenne and non-Duchenne smiles were greater when the studies used videos compared to photographs and when the smiles were "elicited naturally rather than through posing paradigms" (Gunnery & Ruben, 2016, p. 501). As concluded by Krumhuber and Manstead (2009), "Only the spontaneous D[uchenne] smile reflects genuine enjoyment" (p. 817). Further, as was the case in this study, the authenticity of the Duchenne smile to index enjoyment seems more appropriate among members of Western cultures (Thibault, Levesque, Gosselin, & Hess, 2012).

Use of both placebo and no-alcohol control conditions enabled us to examine these two conditions to examine the impact of dosage-set on humor appreciation. In the absence of alcohol ingestion, merely believing one has consumed alcohol did not affect responding. These findings are consistent with prior work generally attributing the effects of alcohol on emotion to the pharmacological effects of ethanol (see Sayette, 2017; Steele & Josephs, 1988). Although placebo and control conditions revealed similar durations of Duchenne smiling, the contrast with alcohol was only significant with the placebo condition. This may reflect a compensatory response sometimes found in placebo conditions, leading to responses in the opposite direction in placebo (but not in a no-alcohol control condition) to those found when consuming alcohol (see Vogel-Sprott & Fillmore, 1999).

The present data highlight the value of testing the emotional effects of alcohol in a social setting. We previously reported that *while consuming their beverages*, participants in this study drinking alcohol experienced more positive affect and bonding and less negative affect than did those drinking nonalcoholic beverages (Sayette, Creswell, et al., 2012). Here we extend this work to reveal that following beverage administration, alcohol-consuming participants find a comedy stimulus to be more pleasurable, as evidenced by Duchenne smiling and mood ratings, than do those drinking nonalcoholic beverages. As noted above, not all research has found strong associations between Duchenne smiling and enjoyment. Consistent with Ruch (1995), however, we did note an association between enjoyment ratings and Duchenne smiling, and together with significant correlations between Duchenne smiling and reported mood, the present data provide further support for the use of Duchenne smiling to capture the emotional experience—referred to by Ruch (1995) as exhilaration—associated with humor. While some investigators may fear the time cost of using FACS to be prohibitive, recent advances in computer vision and machine learning have made the prospect of employing automated versions of FACS to capture spontaneous emotional experiences in a social setting to become realistic (Girard, Cohn, Jeni, Sayette, & De La Torre, 2015).

The present research, distinct from prior studies of alcohol and humor appreciation due to its substantially larger sample size and inclusion of a social context, offers data in line with conventional wisdom that alcohol enhances humor appreciation. This study also suggests important directions for future research testing alcohol and humor. We recommend incorporating into this area of research a social research design with an adequate sample size and use of FACS (in particular coding of the Duchenne smile). Some alcohol theories suggest that not all information is similarly affected by alcohol consumption. For instance,

Curtin and colleagues (e.g., Bradford, Shapiro, & Curtin, 2013) argue that the effects of alcohol are most pronounced when exposed to uncertain outcomes. Steele and Josephs's (1990) alcohol myopia model proposes that alcohol consumption enhances the impact of information that is most salient and immediate at that moment. If humor stimuli were to be more intense, presumably it would be more salient and thus most vulnerable to alcohol effects. Less clear is whether positive and negative stimuli are differentially processed during moments of intoxication (Lang et al., 1999; Sayette, 1993). Accordingly, other factors that remain of interest include varying both the intensity and nature of the humor stimuli (e.g., sexual or aggressive content as opposed to the more innocuous material used here).

Researchers have argued that interpreting affect-related facial expressions requires consideration of the context in which they appear. Smiles occur more readily in social than non-social settings (Parkinson, 2005). Although drinking alcohol in the present study led to longer Duchenne smiles than did consumption of nonalcohol beverages, it remains unclear whether this is attributable to alcohol, or instead to a complex interaction between alcohol and social context. Research therefore is indicated to further distinguish between the effects of alcohol on humor appreciation in isolated and social settings, and in familiar versus unfamiliar social contexts (Fairbairn & Sayette, 2014; Fairbairn, 2017). Such work holds promise for identifying key mechanisms underlying alcohol's ability to enhance humor appreciation and speaks to the value of integrating responses to positive stimuli into etiological models of alcohol use disorder. More broadly, we believe that alcohol offers an ecologically valid and powerful manipulation of social emotional experience. By using an objective, reliable, and unobtrusive system for coding facial expression in real time, the current data highlight the value of incorporating social context into studies of humor appreciation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Descriptive statistics (mean, SE) of dependent variables across beverage conditions

Variable	Alcoholic-beverage condition	Placebo-beverage condition	Control-beverage condition
Duchenne smiling	108.0_{a} (2.7)	85.4_{b} (2.3)	$94.4_{a,b}$ (3.1)
Social smiling	102.4 (3.5)	103.9 (3.6)	101.0 (3.6)
Recommend	59.4	54.2	61.3
Enjoyment	5.8 (.14)	5.7 (.14)	5.9 (.14)
Positive mood	3.4_{a} (.06)	3.1_{b} (.06)	3.2_{c} (.06)
Negative mood	0.5_{a} (.04)	0.8_{b} (.04)	0.7_{c} (.04)

Note: Duchenne and social smiling values are in seconds. Recommend values are percentages of participants that indicated they would recommend the clip to others. Within each row, groups with different subscripts differed significantly ($p < .05$).